

301, and valve 273. As a result, both frame tilting of the front and rear axles 52 and 62 are dampened.

An inclination switch SW7 is connected between terminal 330 of SW1 and ground 329 and "E" of inclination relay "IRI". The switch SW7 is of a well-known type which closes when the vehicle tilts at a predetermined angle, such as 3°-4°, for example. As a result, if the vehicle tilts when the boom is up so that proximity switch 350 is closed and the vehicle is moving, switch SW7 will close to energize coil IRL. This moves contact "C" to contact "A" energizing SW1 moving contact 330 to contact 324, closing valves 291'-295' and placing valve 273 in its cross flow position so that the rear axle is locked. In this manner, if the angle of inclination approaches a critical value, the rear axle is locked to provide a more stable platform and thereby minimized the tendency for the vehicle to tip.

Various features of the invention are set forth in the following claims.

We claim:

1. A vehicle including
 - a frame,
 - a front axle supported at the opposite ends thereof by wheels and connected to said frame for shiftable movement relative thereto,
 - a rear axle supported at the opposite ends thereof by wheels and connected to said frame for shiftable movement relative thereto, and
 - a stabilizer apparatus including
 - a pressure source,
 - first and second fluid-actuated stabilizer assemblies connected respectively to said front and rear axles, one of said first and second stabilizer assemblies normally being locked against extension and contraction in the absence of pressurization thereof by said pressure source, and the other of said first and second stabilizer assemblies normally being free to extend and contract in the absence of pressurization thereof by said pressure source, and
 - hydraulic circuit means connected between said pressure source and said first and second fluid activated stabilizer assemblies and including
 - flow control means operable between
 - a first mode wherein said pressure source is disconnected from said first and second stabilizer assemblies, whereby said one of said stabilizer assemblies is locked against extension and retraction, thereby locking said axle connected thereto against shifting movement relative to said frame, and whereby said other of said stabilizer assemblies is free to extend and retract, thereby permitting shifting movement relative to said frame of said axle connected thereto, and
 - a second mode wherein said pressure source is selectively connectable to said first and second stabilizer assemblies for selective pressurization thereof by said pressure source so as to selectively extend and retract said first and second stabilizer assemblies,
 - wherein said hydraulic circuit includes
 - flow restricting means operable, when said flow control means is in said second mode, for restricting fluid flow to at least one of said stabilizer assemblies to retard the speed of tilting of at least one of said axles.
2. The vehicle set forth in claim 1
 - wherein said hydraulic circuit means is operable in said second mode to couple a first one of said stabilizer

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assemblies to said pressure source and to couple the other one of said stabilizer assemblies to said first one of said stabilizer assemblies, and

wherein said flow restricting means is operable, when said flow control means is in said second mode, for restricting fluid flow to both of said stabilizer assemblies to retard the speed of tilting of said front and rear axles. 5

3. The vehicle set forth in claim 1 wherein said flow control means includes

valve means operable, when said flow control means is in said first mode, for locking one of said stabilizer assemblies and for selectively coupling the other of said stabilizer assemblies to said pressure source for shifting movement of one of said axles, and is also operable, when said flow control means is in said second mode, to selectively couple both of said stabilizer assemblies to said pressure source. 10 15

4. The vehicle set forth in claim 3 wherein said valve means is operable, when said flow control means is in said second mode, for coupling one end of one of said stabilizer assemblies to said pressure source and to couple the other end of said one of said stabilizer assemblies to one end of the other of said stabilizer assemblies. 20

5. The vehicle set forth in claim 4 wherein said valve means includes 25

first valve means for selectively coupling said stabilizer assemblies to said pressure source and to each other, and

second valve means operable, when said hydraulic circuit is in said second mode, for directing fluid through said flow restricting means. 30

6. A vehicle including

a frame,

a front axle supported at the opposite ends thereof by wheels and connected to said frame for shiftable movement relative thereto, 35

a rear axle supported at the opposite ends thereof by wheels and connected to said frame for shiftable movement relative thereto, and 40

a stabilizer apparatus including

a pressure source,

first and second fluid-actuated stabilizer assemblies connected respectively to said front and rear axles, one of said first and second stabilizer assemblies normally being locked against extension and contraction in the absence of pressurization thereof by said pressure source, and the other of said first and second stabilizer assemblies normally being free to extend and contract in the absence of pressurization thereof by said pressure source, and 45 50

hydraulic circuit means connected between said pressure source and said first and second fluid activated stabilizer assemblies and including

flow control means operable between 55

a first mode wherein said pressure source is disconnected from said first and second stabilizer assemblies, whereby said one of said stabilizer assemblies is locked against extension and retraction, thereby locking said axle connected thereto against shifting movement relative to said frame, and whereby said other of said stabilizer assemblies is free to extend and retract, thereby permitting shifting movement relative to said frame of said axle connected thereto, and 60 65

a second mode wherein said pressure source is selectively connectable to said first and second

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stabilizer assemblies for selective pressurization thereof by said pressure source so as to selectively extend and retract said first and second stabilizer assemblies.

5 wherein said vehicle also includes a boom, and means for pivoting said boom through a predetermined vertical angle, and

wherein said flow control means includes

10 means for setting said flow control means in said first mode when said boom is below said predetermined angle and for setting said flow control means in said second mode when said boom is above said predetermined angle.

7. A vehicle including

15 a frame,

a front axle supported at the opposite ends thereof by wheels and connected to said frame for shiftable movement relative thereto,

20 a rear axle supported at the opposite ends thereof by wheels and connected to said frame for shiftable movement relative thereto, and

a stabilizer apparatus including

a pressure source,

25 first and second fluid-actuated stabilizer assemblies connected respectively to said front and rear axles, one of said first and second stabilizer assemblies normally being locked against extension and contraction in the absence of pressurization thereof by said pressure source, and the other of said first and second stabilizer assemblies normally being free to extend and contract in the absence of pressurization thereof by said pressure source, and

30 hydraulic circuit means connected between said pressure source and said first and second fluid activated stabilizer assemblies and including flow control means operable between

35 a first mode wherein said pressure source is disconnected from said first and second stabilizer assemblies, whereby said one of said stabilizer assemblies is locked against extension and retraction, thereby locking said axle connected thereto against shifting movement relative to said frame, and whereby said other of said stabilizer assemblies is free to extend and retract, thereby permitting shifting movement relative to said frame of said axle connected thereto, and

40 a second mode wherein said pressure source is selectively connectable to said first and second stabilizer assemblies for selective pressurization thereof by said pressure source so as to selectively extend and retract said first and second stabilizer assemblies,

wherein said hydraulic circuit includes

55 flow restricting means operable, when said flow control means is in said second mode, for restricting fluid flow to at least one of said stabilizer assemblies to retard the speed of shifting movement of at least one of said axles.

60 8. The vehicle set forth in claim 7

wherein said hydraulic circuit means is operable in said second mode to couple a first one of said stabilizer assemblies to said pressure source and to couple a second one of said stabilizer assemblies to said first one of said stabilizer assemblies, and

65 wherein said flow restricting means is operable, when said flow control means is in said second mode, to restrict

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fluid flow to both of said stabilizer assemblies to retard the speed of shifting movement of said front and rear axles.

9. A vehicle including

- a frame, 5
- a boom mounted on said vehicle,
- means for elevating said boom above a predetermined horizontal angler,
- a front axle supported at the opposite ends thereof by wheels and connected to said frame for shiftable movement relative thereto, 10
- a rear axle supported at the opposite ends thereof by wheels and connected to said frame for shiftable movement relative thereto, and 15
- a stabilizer apparatus including
 - a pressure source,
 - first and second fluid-actuated stabilizer assemblies connected respectively to said front and rear axles, one of said first and second stabilizer assemblies normally being locked against extension and contraction in the absence of pressurization thereof by said pressure source, and the other of said first and second stabilizer assemblies normally being free to extend and contract in the absence of pressurization thereof by said pressure source, 25
 - hydraulic circuit means connected between said pressure source and said first and second fluid activated stabilizer assemblies and including
 - flow control means operable between a first mode wherein said pressure source is disconnected from said first and second stabilizer assemblies, whereby said one of said stabilizer assemblies is locked against extension and retraction, thereby locking said axle connected thereto against shifting movement relative to said frame, and whereby said other of said stabilizer assemblies is free to extend and retract, thereby permitting shifting movement relative to said frame of said axle connected thereto, and 30
 - a second mode wherein said pressure source is selectively connectible to said first and second stabilizer assemblies for selective pressurization thereof by said pressure source so as to selectively extend and retract said first and second stabilizer assemblies said flow control means also including sensing means for sensing when said boom is elevated above said predetermined angle and for setting said flow control means in said second mode. 35

10. The vehicle set forth in claim 9 wherein said flow control means is also operative in 50

- a third mode wherein said first stabilizer assembly is coupled to said second stabilizer assembly for selected shifting movement therewith when said second stabilizer assembly is pressurized by said source to shiftable move said second axle and wherein said first stabilizer assembly is locked when said second stabilizer means is not pressurized, and 55
- wherein said vehicle also includes brake means, and means responsive to the operation of said brake means and said sensing means for setting said flow control means in said third mode. 60

11. The vehicle set forth in claim 10 wherein said hydraulic circuit includes 65

- flow restricting means operable, when said flow control means is in said third mode, for restricting fluid flow

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between said stabilizer assemblies to retard the speed of shifting movement of said front and rear axles.

12. The vehicle set forth in claim 11 wherein said hydraulic circuit means also includes

5 selectively operable means actuatable, when said flow control means is in said third mode, to couple one of stabilizer assemblies to said pressure source and to couple the other of said stabilizer assemblies to said one of said stabilizer assemblies, and

10 wherein said flow restricting means is operable, when said flow control means is in said third mode, for restricting fluid flow to both of said stabilizer assemblies to retard the speed of shifting movement of said front and rear axles.

15 13. The vehicle set forth in claim 12 wherein said stabilizer apparatus includes

a first stabilizer cylinder having a first ram coupled to said front axle, and

20 a second stabilizer cylinder having a second ram coupled to said rear axle.

14. The vehicle set forth in claim 13 wherein said hydraulic circuit includes

25 flow restricting means operable, when said flow control means is in said second mode, for restricting fluid flow to said first stabilizer cylinder so as to retard the speed of shifting movement of said rear axle, and operable, when said flow control means is in said third mode, for restricting the flow of fluid between said first and second stabilizer assemblies.

30 15. The vehicle set forth in claim 14 wherein said selectively operable means includes

35 valve means operable, when said flow control means is in said first and second modes, for selectively coupling said second stabilizer cylinder means to said pressure source for shiftably moving said front axle, and operable, when said flow control means is in said third mode, for selectively coupling said second stabilizer cylinder to said pressure source and for coupling said first stabilizer cylinder to said second stabilizer cylinder.

40 16. The vehicle set forth in claim 15 wherein said valve means is operable, when said flow control means is in said third mode, for coupling one end of one of said first stabilizer cylinder to said pressure source and for coupling the other end of said first stabilizer cylinder to one end of said second stabilizer cylinder.

17. The vehicle set forth in claim 16 wherein said valve means includes

50 a first valve means for selectively coupling said first cylinder to said pressure source and to each other, and second valve means operable, when said hydraulic circuit is in said third mode, for directing fluid through said flow restricting means.

55 18. The vehicle set forth in claim 17 and further including means for sensing when said vehicle is tilted through a predetermined horizontal angle and operable, when said boom is elevated above said predetermined angle, to set said hydraulic circuit in said third mode.

60 19. The vehicle set forth in claim 10 and further including means for sensing when said vehicle is tilted through a predetermined horizontal angle and operable, when said boom is elevated above said predetermined angle, to set said hydraulic circuit in said third mode.

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20. A vehicle comprising:

a frame;

an axle connected to said frame for movement relative thereto; and

a system for locking said axle relative to said frame when said frame is tilted by more than a predetermined angle.

21. The vehicle of claim 20, further comprising a sensor for sensing when said frame is tilted by more than said predetermined angle.

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22. The vehicle of claim 21, further comprising a boom mounted on said frame.

23. The vehicle of claim 22, further comprising a hydraulic system for elevating said boom.

24. The vehicle of claim 23, wherein said locking system includes a hydraulic cylinder connected to said frame.

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25. The vehicle of claim 24, wherein said sensor includes an inclination switch attached to said frame, said switch being operably connected to said hydraulic cylinder.

26. A vehicle, comprising:

a frame;

a boom connected to said frame;

an axle supported at the opposite ends thereof by wheels and connected to said frame for shiftable movement relative thereto;

a stabilizer apparatus including a hydraulic circuit for locking said axle with respect to said frame;

sensors for sensing when said boom is elevated above a predetermined angle and for sensing when said vehicle is tilted through a predetermined vertical angle, said sensors being operably connected to said hydraulic circuit.

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27. The vehicle of claim 26, wherein said predetermined vertical angle is not greater than about four degrees.

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28. The vehicle of claim 27, wherein said predetermined vertical angle is not greater than three degrees.

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29. The vehicle of claim 28, wherein said hydraulic circuit includes a flow restrictor for restricting hydraulic flow in said stabilizer apparatus.

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30. The vehicle of claim 29, wherein said stabilizer apparatus includes a stabilizer cylinder having a first ram coupled to said axle.

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31. The vehicle of claim 30, wherein said stabilizer apparatus includes a valve for operating said vehicle in at least first and second modes, said valve being connected to said stabilizer cylinder.

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32. A vehicle, comprising:
 a frame;
 a boom connected to said frame;
 a rear axle supported at the opposite ends thereof by wheels and
25 connected to said frame for shiftable movement relative thereto;
 a stabilizer apparatus for reducing the tendency of said vehicle to tip,
 said stabilizer apparatus including a hydraulic circuit for locking said axle with
 respect to said frame when said boom is elevated above a first predetermined
 angle and said frame is tilted through a second predetermined angle.

33. The vehicle of claim 33, wherein said stabilizer apparatus includes a switch for actuating said hydraulic circuit when said frame is tilted through said second predetermined angle.

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